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Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms

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Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms

Thanks

- **All participants**
- **FISWG**
- **ENFSI-Face**
- **OSAC-Facial Identification**
- **International Summer School on Biometrics**

- **FBI**
- **IARPA**
- **NIJ**
- **Australian Research Council**

Open access and download for free at
http://www.pnas.org/content/115/24/6171

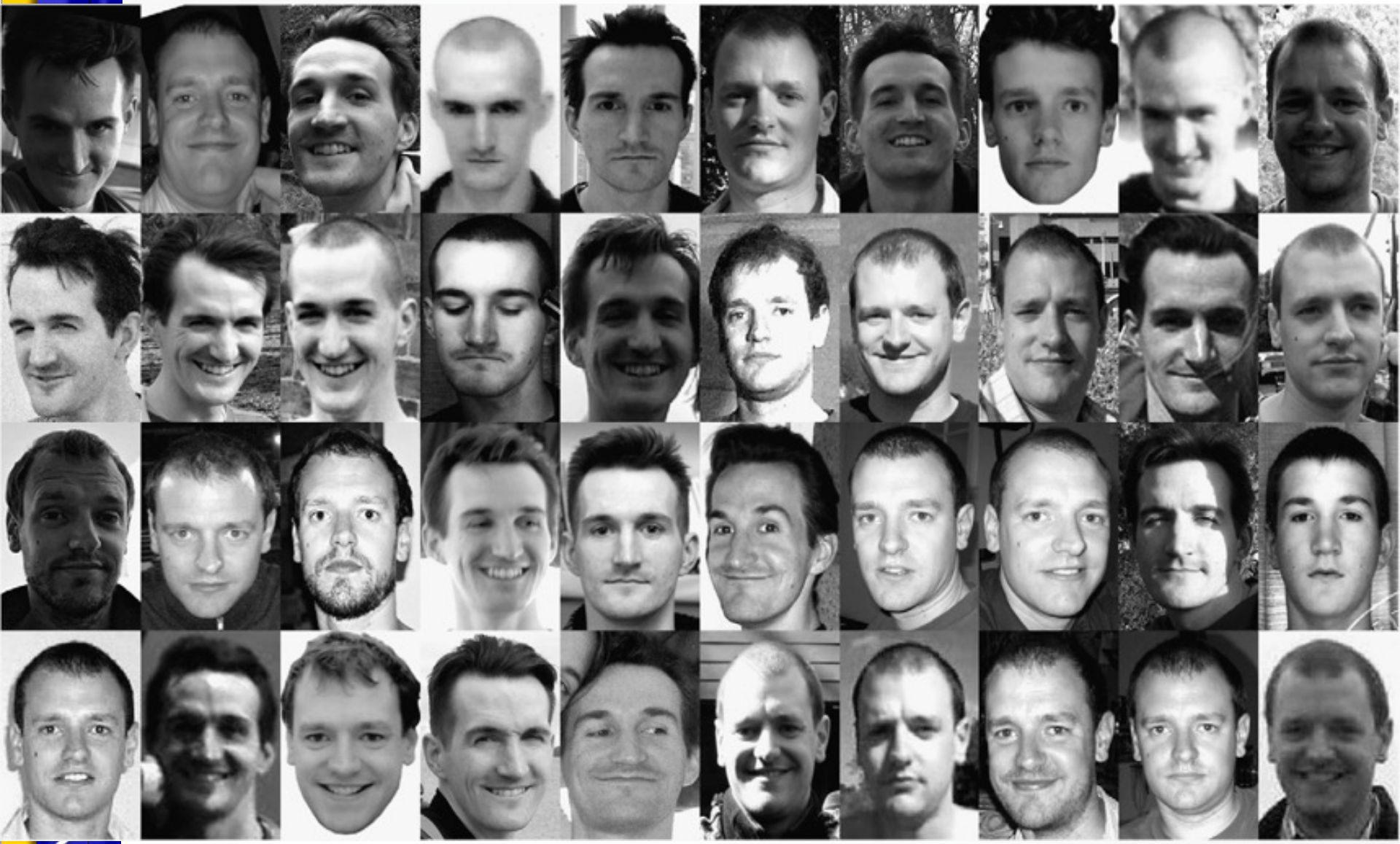
Scope of Study

- First to measure accuracy of facial examiners using tools and methods
- First to compare facial examiners and super-recognizers
- First to compare facial examiners and algorithms
- First to fuse facial examiners with algorithms

Pop Quiz

Who is this person?

How Many People?



Jenkins, White, Burton (2011)

What is a super-recognizer?

ELSEVIER
biometric TECHNOLOGY TODAY
ISSN 0969-4765 April 2016 www.biometrics-today.com

FEATURE

Humans vs machines: the future of facial recognition

Tim Ring, journalist

Tim Ring

London Metropolitan Police Commissioner Sir Bernard Hogan-Howe (left) presents the force's Staff of the Year award to 'super recogniser' Detention Officer Idris Bada.

Courtesy T. Ring, Biometric Technology Today, 2016

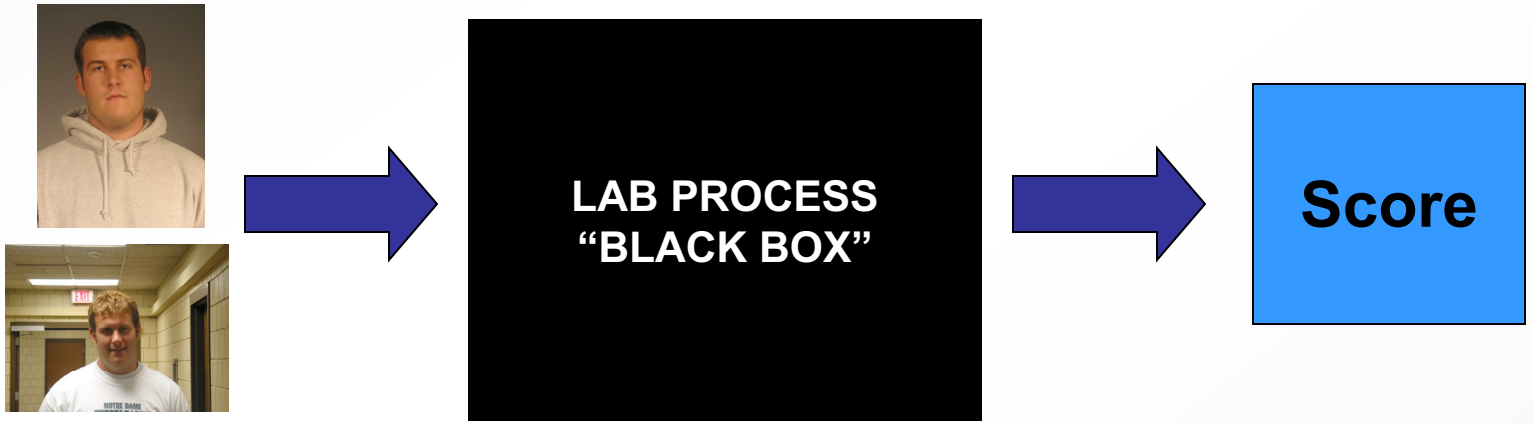
What is a facial examiner?

- Comprehensive comparison of faces in images
- Write detailed reports
- Prepared to testify in court
- Extensive training (2-4 years)

Credit: J. Stoughton/NIST

Black Box Study

- Measure performance of Forensic Facial Examiners *in situ*.



- Examiners were allowed access to lab procedures, tools, methods, resources, and time schedule (more or less).

General Rules

- 20 pairs of face images
  - Pre-screened by humans and machines to be ***extremely*** challenging
- 7 point comparison scale
- 3 months to complete comparisons

Same-identity pair

Different-identity pair

Selecting 20 Challenging Fair-pairs

9,307 images
570 subjects

Stratification By Algorithms

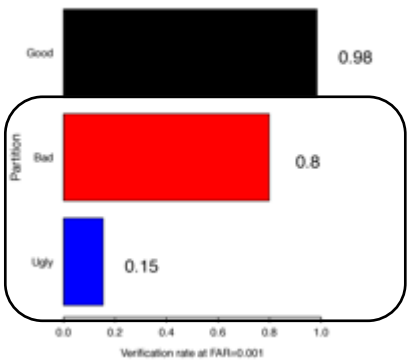
Select

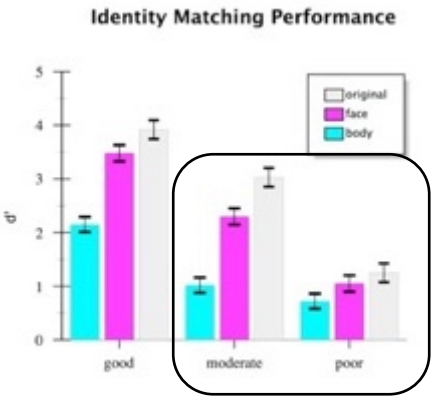
Student Human Performance

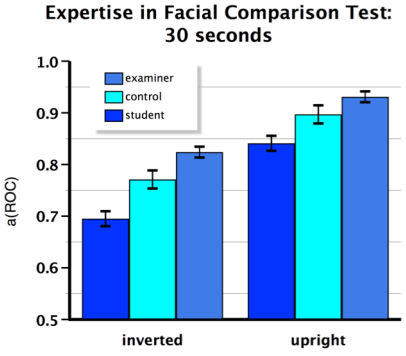
Select

Face Examiners 30 seconds

20 Extremely Challenging Face-pairs







Comparison / Identification / Matching

+3	The observations strongly support that it is the same person
+2	The observations support that it is the same person
+1	The observations support to some extent that it is the same person
0	The observations support neither that it is the same person nor that it is different persons
-1	The observations support to some extent that it is not the same person
-2	The observations support that it is not the same person
-3	The observations strongly support that it is not the same person

Four Subject Groups ++

- Facial forensic examiners (n=87, 5 continents)
  - Examiners (n=57)
  - Reviewers (n=30)
- Super-recognizers (n=13)
- Fingerprint examiners with no face experience (n=53)
- Undergraduate Students (n=30)

- **Algorithms**

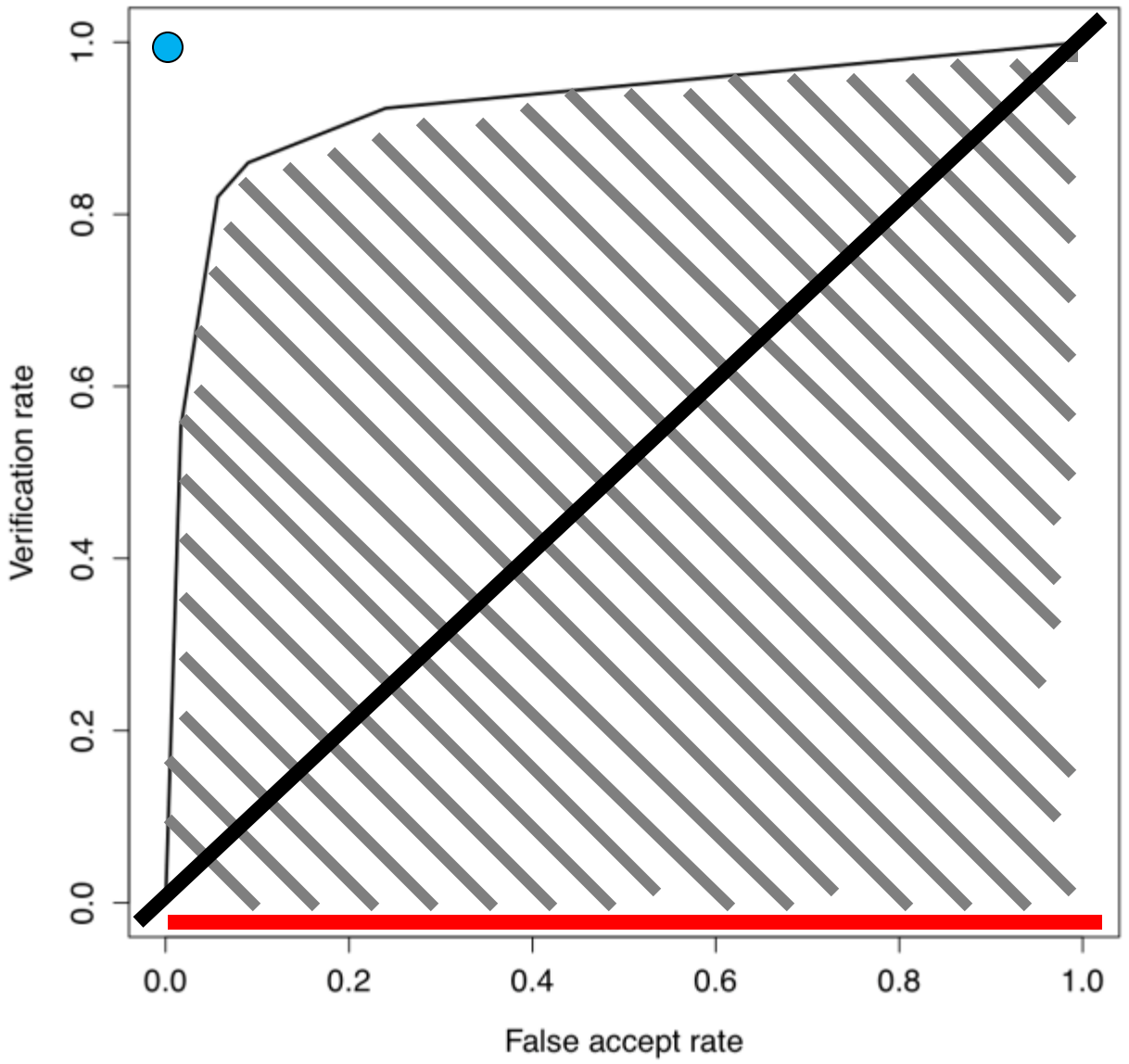
Algorithms

- VGG-Face (A2015)
  - Benchmark algorithm from Oxford
  - Deep convolutional neural network (DCNN) based
- U of Maryland
  - Rama Chellappa's group
  - 3 algorithms (A2016, A2017a, A2017b)

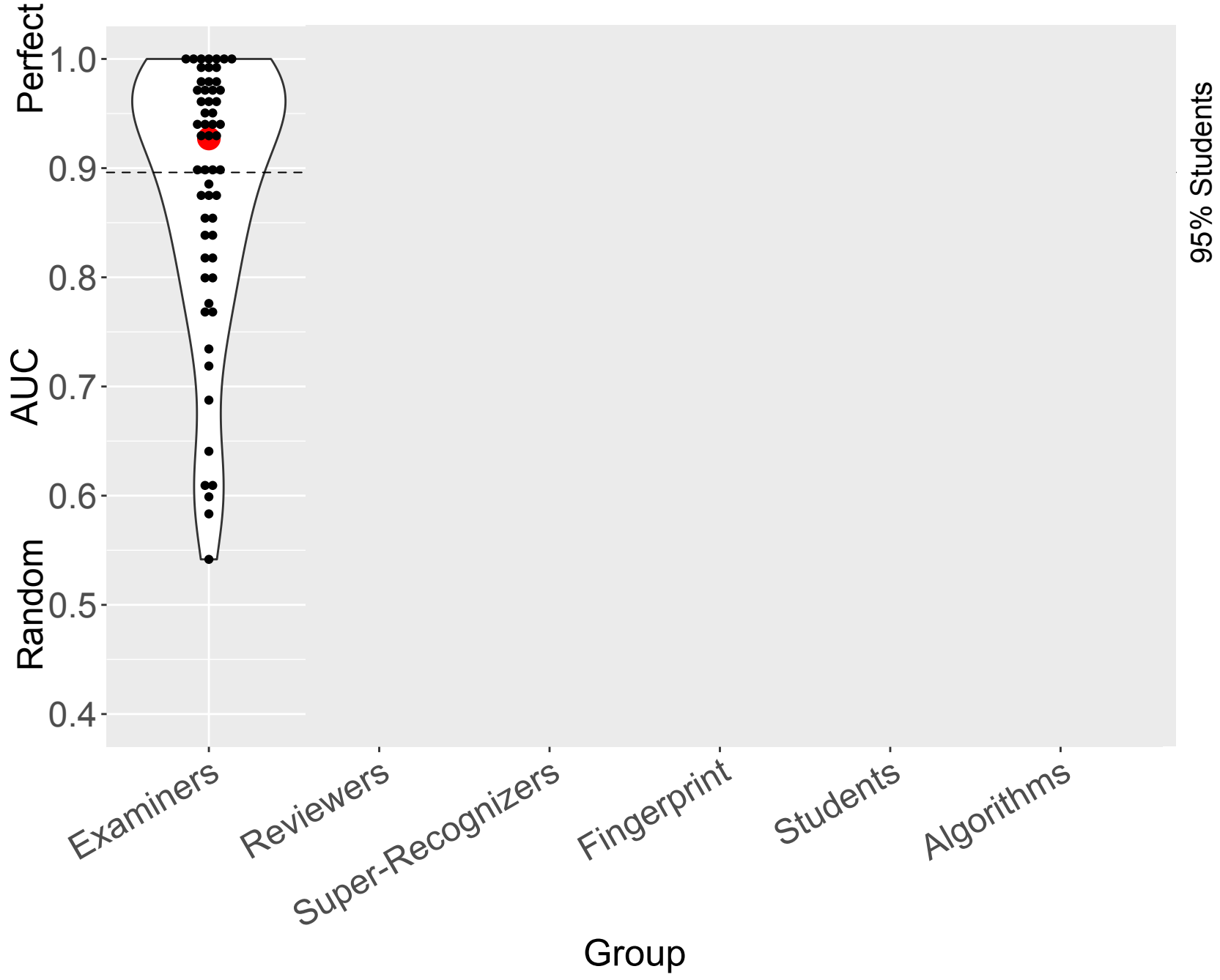
Four Major Questions

- Do facial examiners have superior ability?
- Is there a difference in accuracy between facial examiners and super-recognizers?
- How do algorithms compare to the humans with superior ability?
- Does fusion help?

Area Under Curve (AUC)



Comparison across subject groups and algorithms



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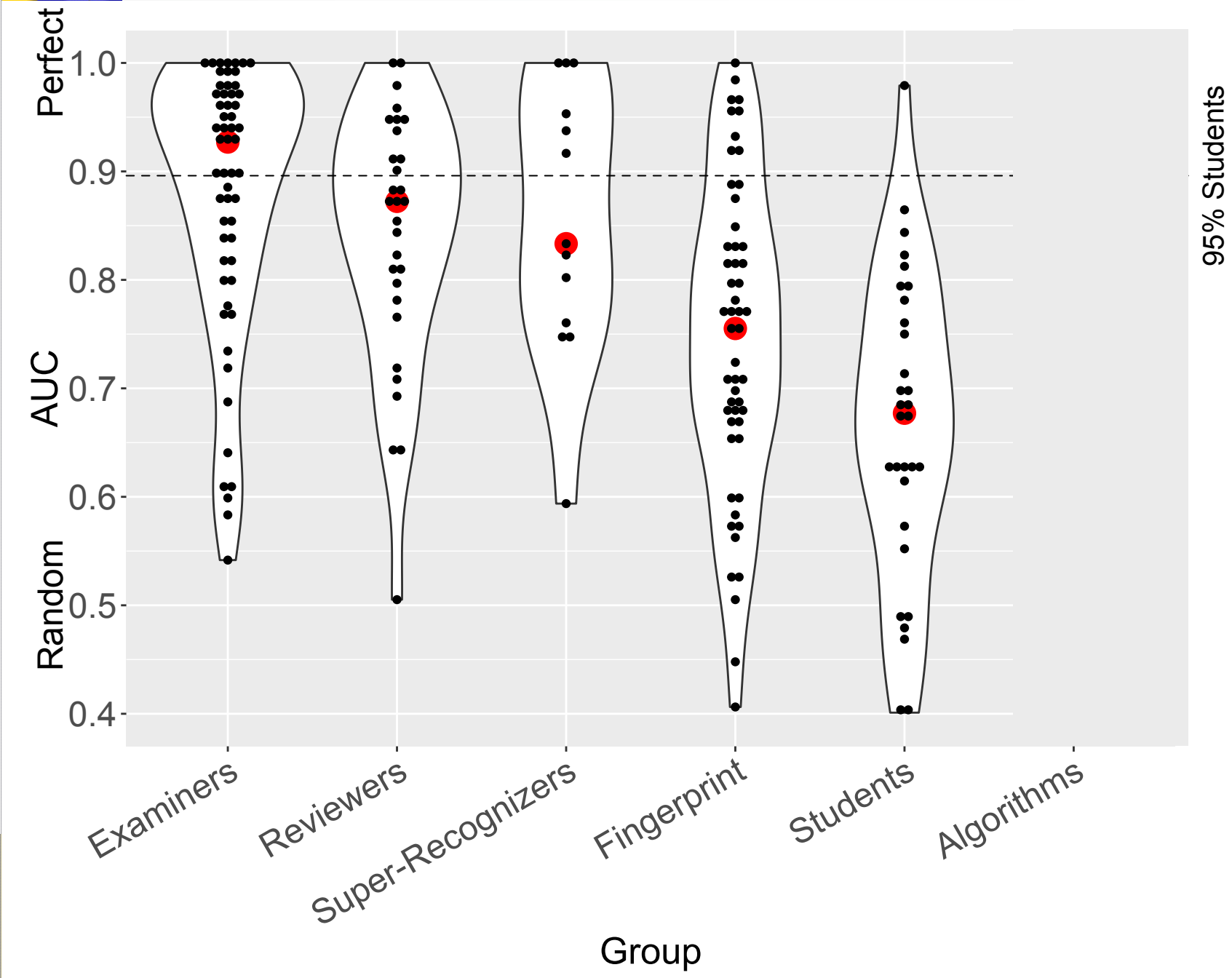
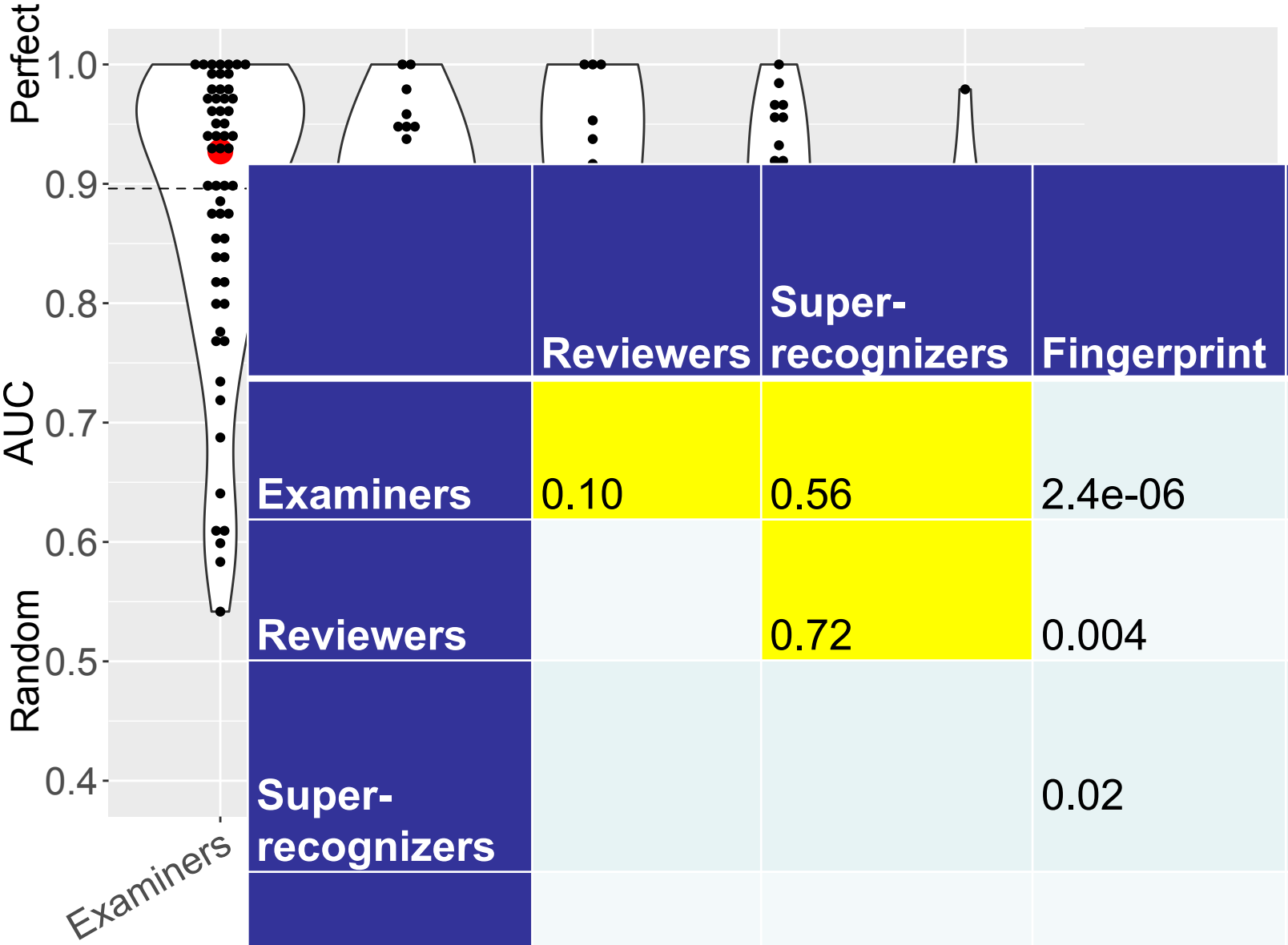
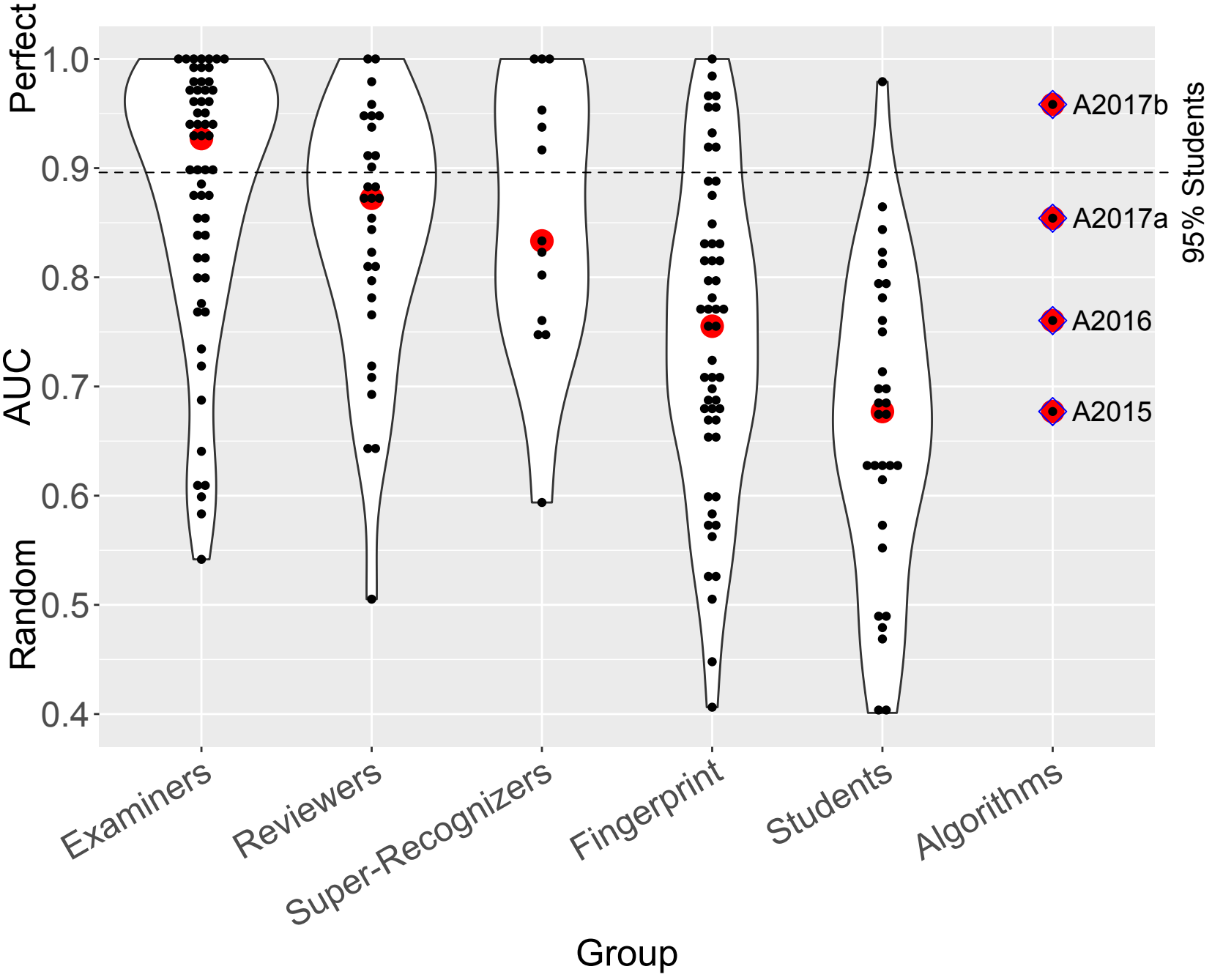


p-values for Mann-Whitney statistic

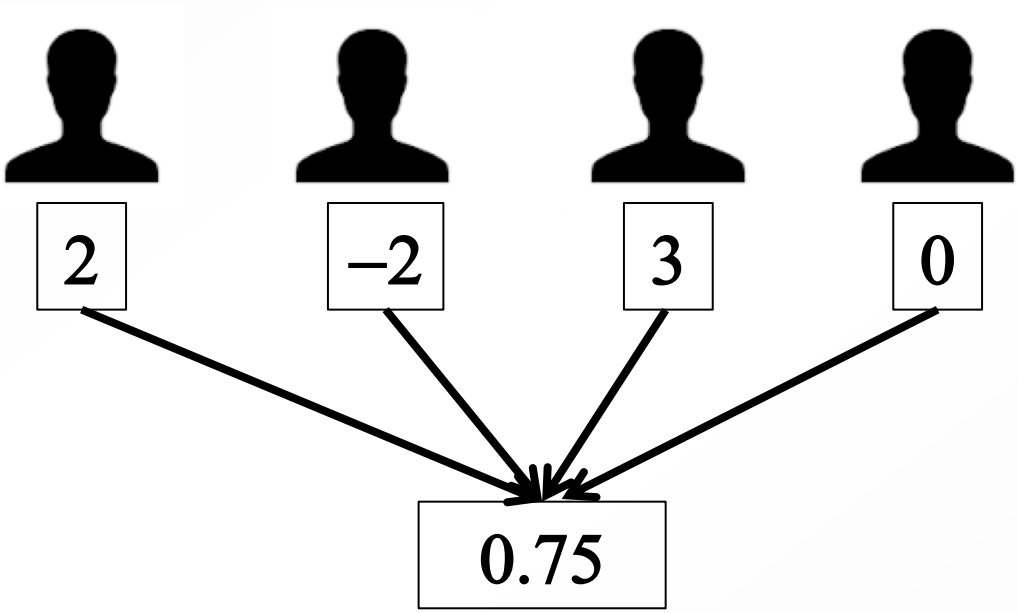


	Reviewers	Super-recognizers	Fingerprint	Students
Examiners	0.10	0.56	2.4e-06	2.5e-08
Reviewers		0.72	0.004	4.0e-06
Super-recognizers			0.02	0.0005
Fingerprint				0.02

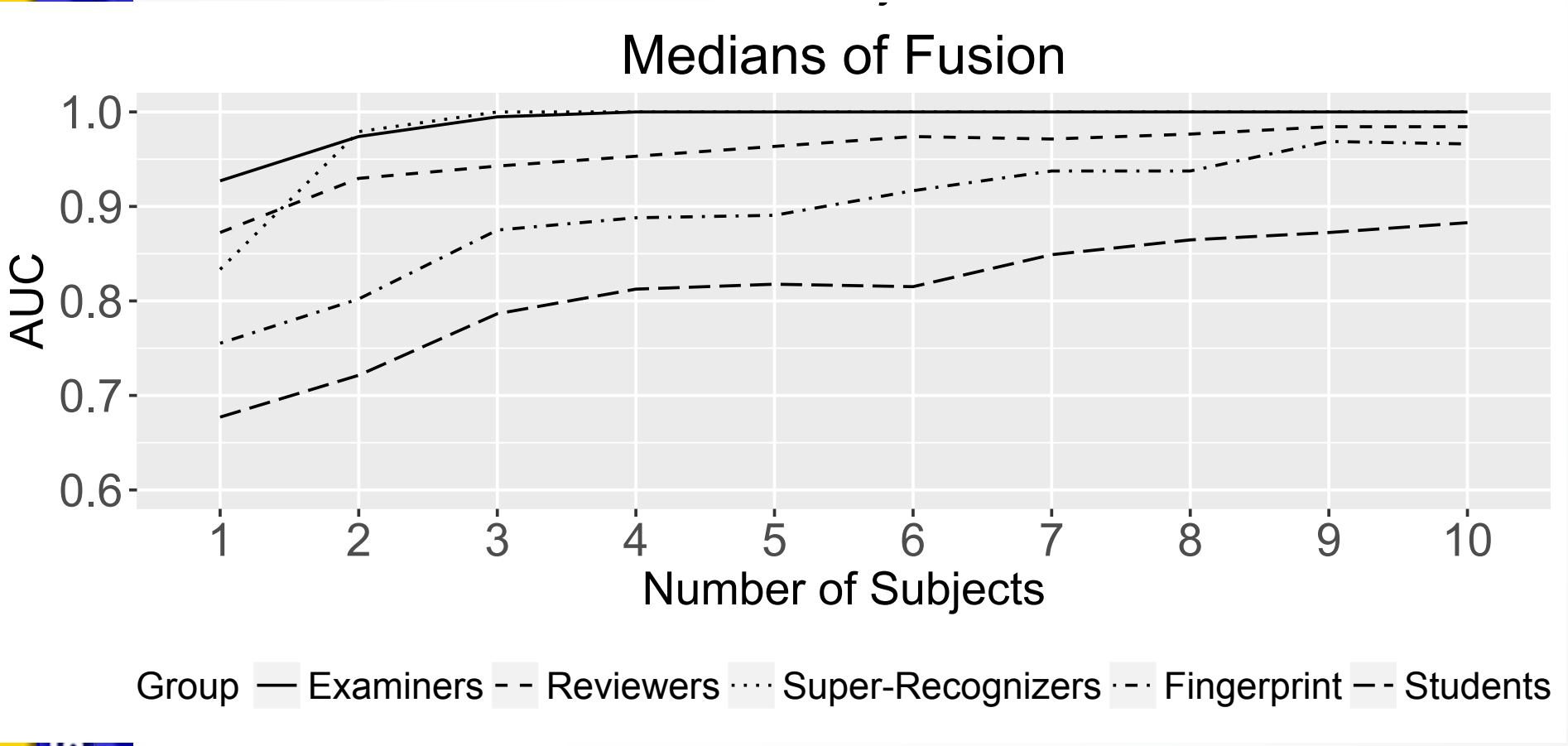
Comparison across subject groups and algorithms



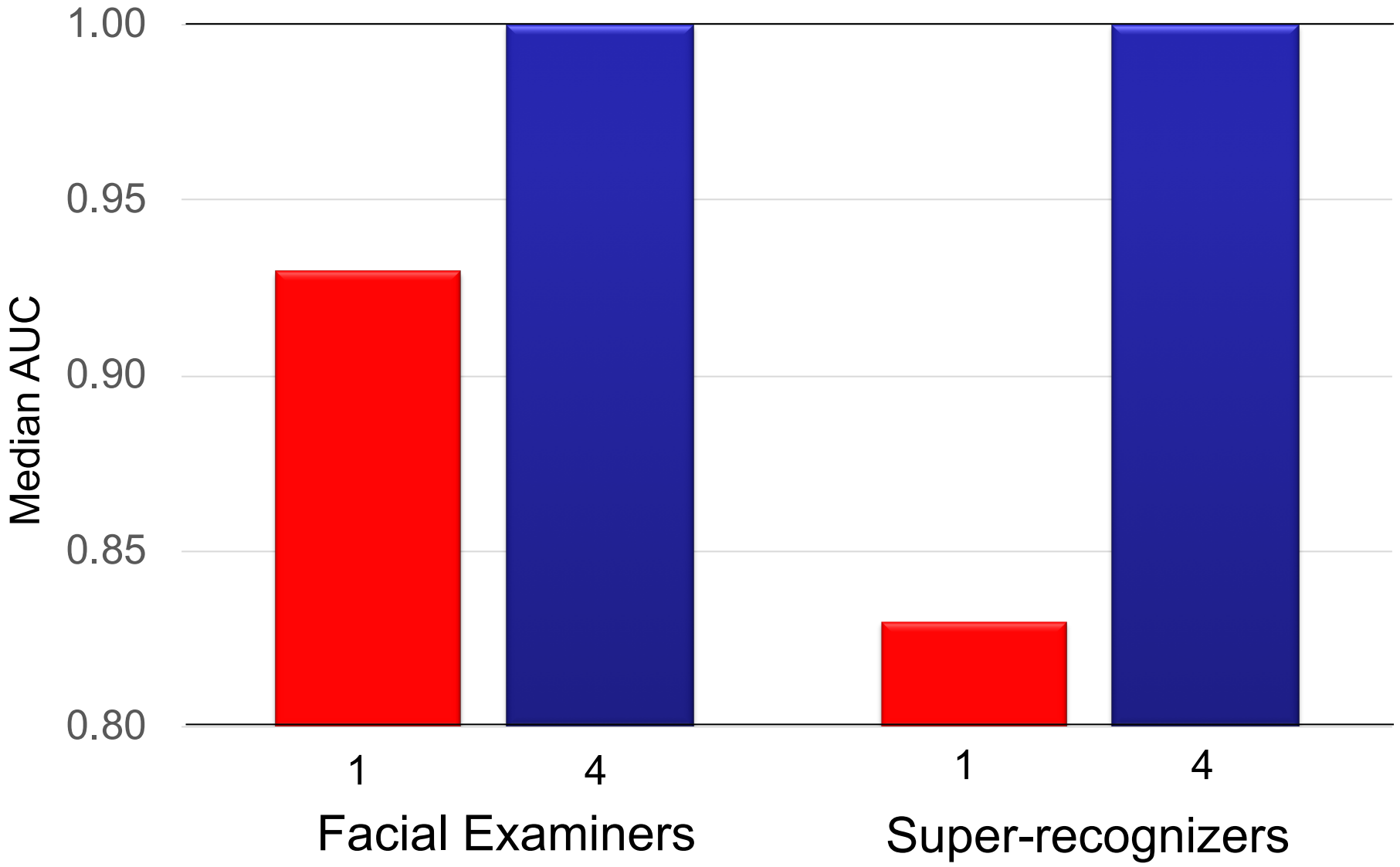
Independently Fusing Human Ratings



Effectiveness of Fusion

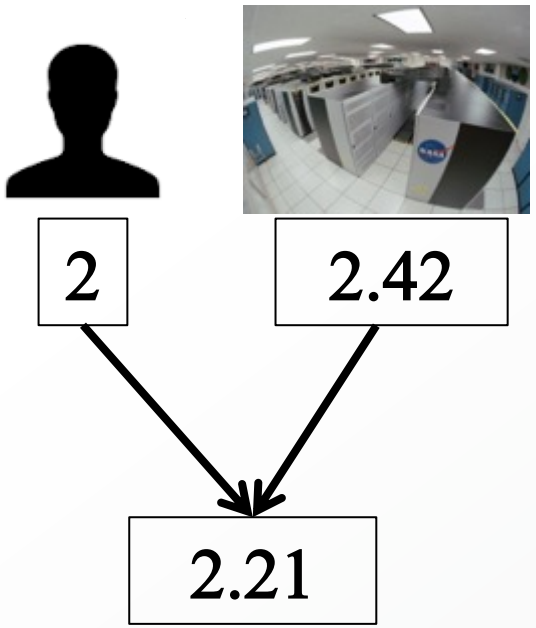


Fusing is Very Effective

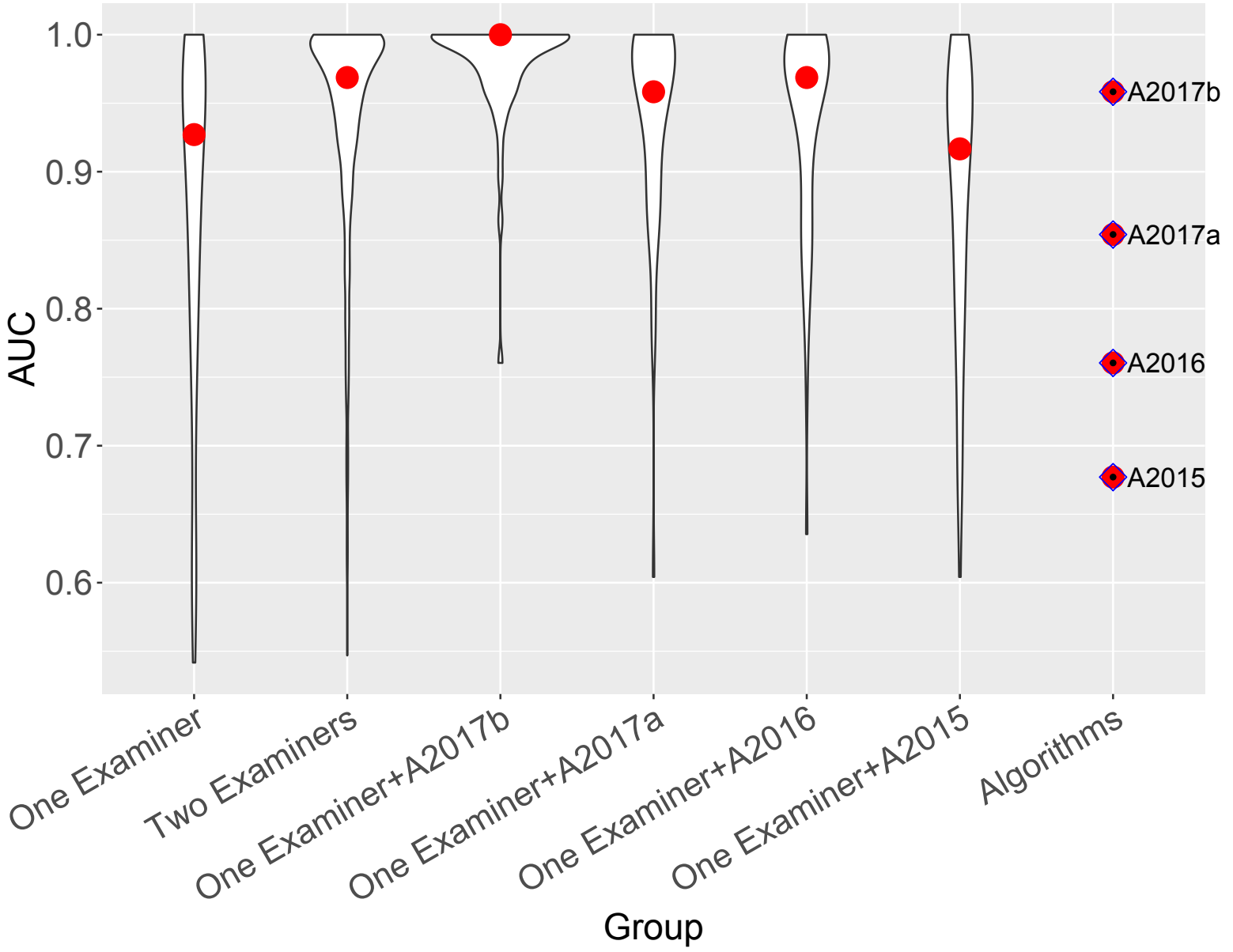


Can fusing examiners and algorithms improve accuracy?

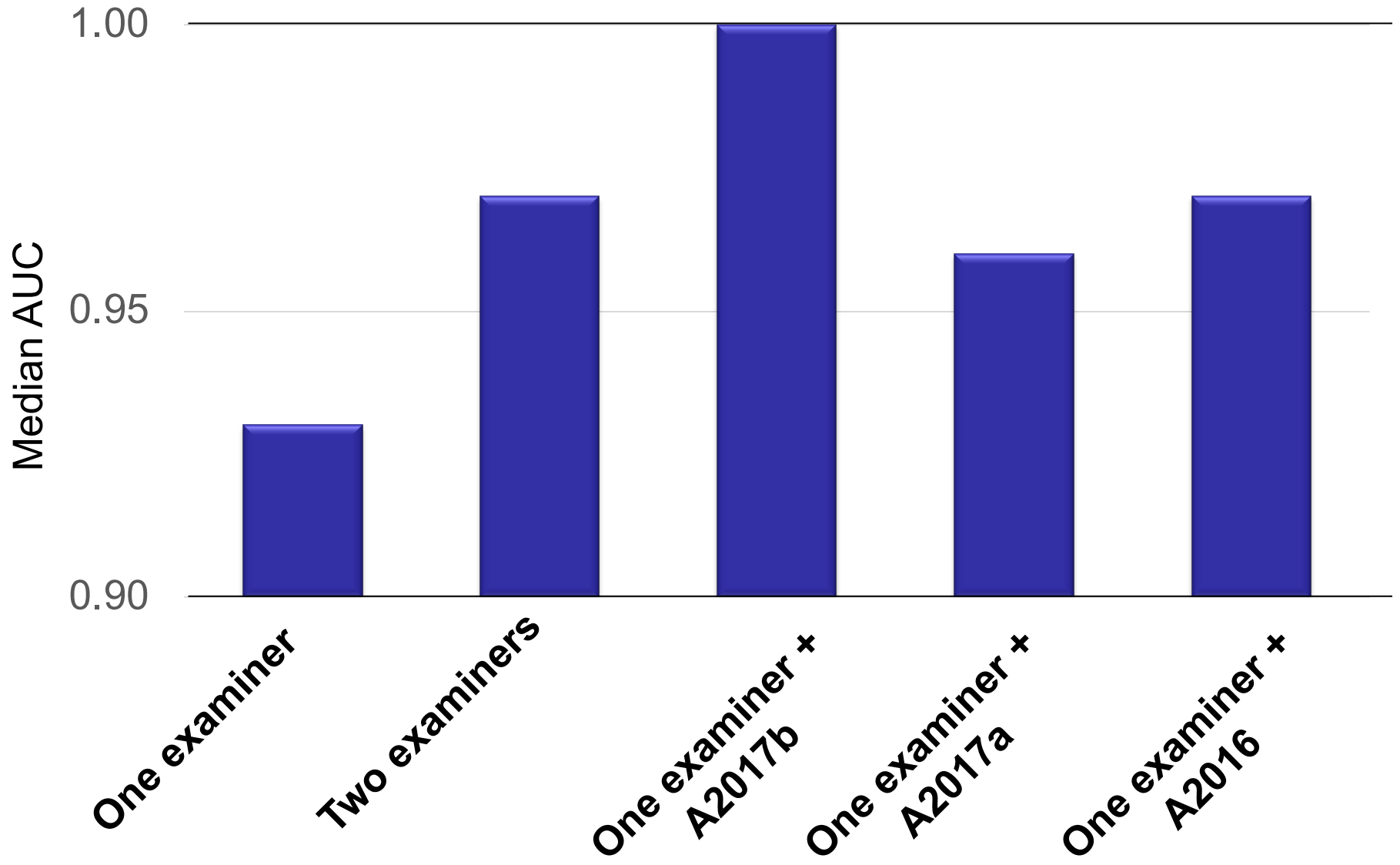
- Rescale algorithm scores
- Fusion by averaging



Fusing Examiners and Algorithms



Fusing Examiners and Algorithms



Conclusions

- Facial examiners are significantly better than the general population

- No statistical difference among examiners, reviewers, and super-recognizers.
- Best algorithm is competitive with best humans
- Fusing human judgements is effective
- Performance optimized by fusing one facial examiner and A2017b.

Next Steps

- Harder test of face recognition ability
- Accuracy across changes in
  - Pose
  - Blur
  - Video
  - Camera quality
- The other race effect

Future Goal

- Transitioning human-machine fusion to practice
  - Work with facial forensic community
  - Explaining algorithms decision
  - How it complements human decisions
  - Classic AI problem

General Audience Article

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FEATURE

The great debate: study proves whether people or algorithms are best at facial ID


P Jonathon Phillips


Alice J O'Toole

P Jonathon Phillips, NIST and Alice J O'Toole, University of Texas at Dallas

Thank You